

Towards an index with artificial intelligence to evaluate vulnerability to climate change in micro-watersheds in Colombia

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This study constructs and applies an index to estimate vulnerability level to climate change (CCI) in tropical Andean micro-watersheds. The CCI was constructed with a combination of two analytical methodologies: Pressure-State-Response (PSR) indicators and fuzzy logic from artificial intelligence. The PSR model aims to develop indicators of sustainable development, organized in three categories: pressure (P), state (S) and response (R). The PSR framework is based on a concept of causality, covers causes and effects influencing a measurable state and seems highly capable of showing information to end users in a causal way by differentiating between causes, effects and human responses to control the extent of anthropogenic impacts on nature. Fuzzy logic is a mathematical discipline based on fuzzy set theory instead of classical mathematics. The goal of fuzzy logic algorithm is to establish quantitative relations between inputs and outputs by qualitative relations. Fuzzy sets can have a variety of shapes, trapezoidal and triangular functions were defined in this study.

One pressure indicator, three status and two response indicators were defined. Each indicator is associated with a fuzzy logic function. For the operation of the index, 234 decision rules were generated, which were programmed in MATLAB program. The index was applied to the tropical Andean microwatershed named Bolo located in the Department of Valle del Cauca in Colombia. This micro-watershed has suffered a huge environmental damage, because of the change in the use of the land, the increase of the population, the discharge of untreated domestic wastewater, the poor management of the solid wastes, and the discharge of the acid coal water. These circumstances generate different kind of conflicts, especially the access to the water, degrading uses of water and activities that affects the quantity and quality of water. Institutions that work in this area sometimes contribute with solutions, but sometimes make worse these problems. With the application of the CCI index, the high level of vulnerability of this microwatershed was evidenced in the low, medium and high zone. Knowledge management describes the strategies and processes of acquiring, converting, applying, protecting and transferring knowledge to improve decisions.

Keywords : index; vulnerability; Andean micro-watershed; fuzzy logic; Pressure-State-Response indicators; climate change.